ON A NEW SPECIES OF POTOROÜS (MARSUPIALIA) FROM A CAVE DEPOSIT ON KANGAROO ISLAND, SOUTH AUSTRALIA

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Plates V, VI and VII

To the generosity of the late Dr. A. M. Morgan, the South Australian Museum owes a collection of mammal bones taken in the so-called Kelly's Hill caves on Flinders Chase in the south-western portion of the island.

While the collection is an interesting one as indicating the former presence on the island of mammals which are now either absent or excessively rare, all the species represented, save one, are identical with, or closely related to, those indigenous to the adjacent South Australian mainland. The exception is found in a single skull of a rat-kangaroo, which is clearly an undescribed species of *Potoroüs,* allied to the West Australian *P. platyops.*

On searching other collections of Kangaroo Island material in the Museum, a second skull of the same animal, with a part skeleton, has been found. This was forwarded to the Museum from the same cave in February, 1926, by Miss Edith May.

Cranial Characters

Both skulls are damaged and that from the Morgan collection is without a mandible. By a fortunate chance, however, the damage has not affected the same areas in both skulls, so that taken together they give an almost complete version of the cranial anatomy of the animal. Both skulls are from mature or even aged animals, with the secator and M^4 in place, and in both the molar crowns show a considerable amount of wear. One is appreciably larger than the other (see table), and for purposes of comparison with the British Museum specimen of *P. platyops,* measured by Thomas (1), this has been assumed to be a male also, though, of course, it is by no means certain that such was the case.

The skulls are very small and delicate, and the animal evidently shared with *P. platyops* the distinction of being the smallest member of the subfamily, and, indeed, of the whole of the Macropodidae, with the exception of *Hypsipymnodon.* In general shape the skull is quite *Bettongia*-like, roughly comparable to *B. penicillata* for example; the shortened muzzle, smooth outlines and absence of crests making it very unlike an adult of its congener, *P. tridactylus.* That its place is with *Potoroüs,* however, is plainly attested by the characters of the dentition and by the structure of the muzzle region, of the zygomata and of the mandible.

The nasals are relatively shorter than in *tridactylus* and much more expanded posteriorly, though less so than in *platyops.* Their maximum breadth goes but

2·2 times into their length, and their minimum breadth along their junction with the premaxillae, 5·8 times. The general shape of the nasals is similar to that of *platyops,* but both postero-internal and postero-external angles are more acute than in the West Australian species. The posterior portion of the muzzle region is greatly expanded from side to side, but at the maxillo-premaxillary suture is suddenly constricted, and from that point to the anterior nares the nasal chambers are narrow and tubular, with their vertical and transverse diameters about equal. This is a good distinction of *Potoroüs* from *Caloprymnus, Bettongia* and *Aepyprymnus,* in all of which the anterior nares show a more or less marked deepening from above downwards, as in the typical Macropodinae. The relative areas of premaxilla and maxilla on the walls of the nasal chambers are about as in *tridactylus,* but the sharp procumbent spur on the anterior margin of the premaxillae in the latter species is absent or only slightly indicated.

The frontal and interorbital region is quite parallel-sided and remarkably broad; even more so than in *platyops.* In the larger of the two skulls the interorbital width is nearly half the maximum width of the skull across the zygomata. The supraorbital margins are smooth and rounded, but in the larger skull there is a slight tuberosity at the site of the post-orbital process. The brain case is deeply vaulted and very smoothly rounded, the temporal ridges but slightly indicated, the sagittal crest absent and the lambdoids very slight. The contours of this part of the skull are practically those of a very young *tridactylus* at the M^1 stage.

The plane of the occiput is less oblique to the basi-cranial axis than in *tridactylus,* and does not differ notably from that in some *Bettongia.* There is a thin crescentic interparietal. The paraoccipital processes scarcely exist as free projecting elements, but are bent forward and closely applied to the posterior border of the bullae, as in some Peramelidae. The alisphenoid bullae are much more expanded than in *tridactylus,* but variably so in the two skulls—the smaller having considerably the larger bullae. In this example the antero-posterior diameter of the expanded portion is 9 mm., the transverse diameter 5·6 mm., and its projection below the level of the lower margin of the tympanic annulus 4·2 mm.

The zygomatic arch is curiously shaped in a lateral view. The anterior root of the malar is broad and powerful, but rapidly narrows to a thin weak infra-orbital bar. The upper margin of the squamosal portion is feebly concave and it slopes down to the posterior root, though much less steeply than in *tridactylus.* The squamosal makes a wide contact with the frontal.

The posterior palate has been damaged in both skulls, but the pterygoid fossae seem to have been shallower than in *tridactylus* and, therefore, much shallower than in the rest of the subfamily. The palatine vacuities are longer, extending forward to the front of M^2 in one skull and the middle of M^1 in another. Anterior palatal foramina very small, as in *platyops.*

The mandible shows the typical *Potoroüs* characters of slenderness, comparatively straight inferior border, a weak coronoid process meeting the alveolar border at a wide angle, and a condyle relatively large, expanded from side to side, and with its antero-internal angle produced to a spur.

DENTITION

All the teeth of the adult dentition are represented in either one or other of the two skulls, except the upper second and third incisors. All the teeth are considerably worn, and the finer detail of crown pattern in most cases lost. In the upper series the first incisor is a comparatively short broad tooth, showing none of the exaggerated styliform specialization of *tridactylus;* it projects beyond the alveolar margin only about 3 mm., as against 8 mm. in *tridactylus,* but resembles its larger ally in that its anterior surface is nearly vertical and lacks the more or less marked recurvature of all the other genera. In *platyops* this tooth is stated to be "very long" (Thomas). The alveoli of the missing second and third incisors indicate minute teeth.

A single detached canine is a fairly strong functional tooth of about the same relative proportions as in *tridactylus.* The secator is a reduced version of that of *tridactylus;* the anterior lobe strongly developed into a subconical cusp projecting well below the general level of the blade; the outer surface strongly emarginate and bearing two broad shallow grooves; the long axis parallel to the basi-facial axis of the skull. The molar rows are less straight than in *tridactylus,* converging gently towards M^4. $M^2 > M^1 > M^3 > M^4$. The crowns of all the molars are squarer and less elongate antero-posteriorly than in *tridactylus;* their surfaces smooth through wear, but originally quadri-tubercular and their pattern very similar to *tridactylus* and the primitive species of *Bettongia.* M^4 a relatively smaller tooth than in *tridactylus;* its crown area little more than that of the posterior lobe of M^3. The posterior lobe of M^4 reduced, but distinctly bifurcate.

In the mandible the incisor is a broad, somewhat round-pointed tooth, more spatulate than in most of the Potoroinae and without the upward phalangerine curvature of *tridactylus* and *platyops.* P^4, 3·9 mm.; obscurely 2-grooved. M^1, quadricuspid. $M^2 > M^3 > M^1 > M^4$.

In comparing the skull characters of the present form with those of *P. platyops,* I have had to rely entirely upon the first description of Waterhouse (2), of Thomas *(loc. cit.,* 121) and the supplementary remarks of Bensley (3) upon the dentition. These notices, together with the single figure of Thomas, leave the skull of *platyops* still very imperfectly described, and many details which would have amplified the comparison are lacking. The chief differences which have been brought to light may be summarized as follows: 1, the nasals in the South Australian animal are longer, less expanded posteriorly, and with slightly different conformation of their posterior margins; 2, the interorbital region is wider; 3, the palate is longer; 4, the molar rows are longer; 5, the first upper incisor is shorter; 6, the lower incisor is more specialized and lacks some of the phalangerine characters of *platyops.*

While it is obvious that the Kangaroo Island form is closely allied to the West Australian *platyops,* and possible that the first four differences might disappear if adequate series of both could be measured, five and six appear to be true structural differences indicating differing degrees of specialization. Moreover, the two localities (Kangaroo Island and Albany) are over 1,000 miles apart, and while *platyops* is (or was in 1840) a living species, the circumstances of the present find necessitate one regarding it as a fossil or subfossil form, with the possibility of a considerable antiquity⑴ in post-Pleistocene time. For these reasons I propose to distinguish it under the name *Potoroüs morgani* with a part skull without mandible, registered number P. 3413, and a part skull with mandible, registered number P. 168, as cotypes of the species, in the South Australian Museum.

Associated with the larger skull is a part skeleton forwarded at the same time. With the exception of three fragments evidently derived from a larger animal, possibly *Trichosurus,* these bones are in the same condition of preservation as the skull and show the same characteristic surface spattering (since removed). They exhibit, moreover, morphological characters which place them unmistakably with *Potoroüs,* and that they are derived from the same animal that furnished the skull, I believe to be beyond reasonable doubt. Though I propose to found the species, so far as diagnosis is concerned, upon cranial characters alone, some account of the rest of the skeleton may be of interest, as those of *gilberti* and *platyops* have never been examined, and the osteology of *Potoroüs* as recorded, thus rests entirely upon the existing species, *tridactylus,* regarded by Bensley as a comparatively specialized form.

The bones, like the skull, give evidence of considerable age in the animal furnishing them, and in the examination which follows they have been compared with a skeleton of a similarly aged male of *tridactylus* from Tasmania, and with skeletons of three other Victorian examples at varying stages of immaturity. Wherever dimensions are given for *tridactylus,* however, they are derived from the aged male alone. All dimensions in millimetres.

The fore limb

The clavicle, scapula, humerus, radius and ulna of both sides are present, but the manus is represented only by a carpal element and some phalanges.

The *clavicle* has a maximum length across the arc of curvature of 14·3, as against 24·1 in *tridactylus.* It is of the same general form but more strongly and suddenly expanded at the sternal extremity, and wider also below the attachment to the acromion.

The *scapula*—Maximum length, 34·3; maximum breadth, 12·4. Somewhat narrower than in *tridactylus,* the ratio length/breadth 2·7, as against 2·3. The

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(1) The appearance of the bones does not encourage this idea so far as the present specimen is concerned. They are quite unmineralized and, when cleaned from some surface spatterings, quite unstained and have a very "recent" look. It is possible that the animal may have persisted on the island till quite recent times, or even still be extant there.

supra-scapular border more rounded, its angle with the glenoid border less acute, and the anterior border approaching the coracoid, less deely emarginate.

The *humerus*—Maximum length, 31·1; distal breadth, 8·1; proximal breadth, 6·7. Agreeing closely with immature bones of *tridactylus* in structural features and proportions, but the shaft relatively more slender than in the adult of that species, and less expanded distally. The proportion of distal expansion to length is 3·8, as compared with 3·3 in the larger animal.

The *radius*—Length, 38·1. Much as in *tridactylus,* in which the length is 51·8.

The *ulna*—Maximum length, 45·8. *Tridactylus* 64 (ca.). The shaft more slender, somewhat rounder in section, and less flattened from side to side; tapering rapidly distally to a very delicate styloid process. The anconeal process appearing massive in comparison with the distal part of the bone, but its proportion to the bone as a whole much the same in both species. Immediately distad to the coronoid process of the notch, its lateral surface is conspicuously hollowed out over a space of 6 mm., beyond which the surface is distinctly ridged for a like distance—neither feature marked in the larger animal.

The proportion which the length of scapula, humerus and ulna individually bear to the limb as a whole is exactly the same in both species.

The *pelvis*—The following figures give the chief dimensions of this bone in *morgani* and *tridactylus,* respectively. The number in brackets is the quotient obtained by dividing the maximum length by the value in question. This arrangement is adopted in the succeeding sections as well. Maximum length, 54·1, 83·8; ischial breadth, 31·9 (1·7), 54·9 (1·5); acetabular breadth, 30·5 (1·7), 50·0 (1·7); illiac breadth, 33·2 (1·6), 56·0 (1·5); length of pubic symphysis, 21·9 (2·5), 34·0 (2·5).

The pelvis presents several minor points of distinction. It is proportionally longer and narrower, the ischial tuberosity is more developed, the illiac wing tapers to the extremity, and the pubics along the symphysis are much narrower and more fragile, with a corresponding alteration in the shape of the obturator foramen.

The epipubic of the right side has been preserved (detached); in shape and relative size much as in *tridactylus;* its maximum length 10·7, and width 3·3.

The hind limb

This is represented by femur, tibia and fibula of both sides, quite undamaged, and by a number of pedal elements.

The *femur*—The chief dimensions of this bone in *morgani* and *tridactylus* are as follows: greatest length, 56·3, 85·4; proximal breadth across the trochanters, 10·5 (5·3), 16·2, (5·3); diameter of head, 4·3 (12·0), 8·3 (10·3); distal breadth, 9·6 (5·8), 14·0 (6·1); minimum (antero-posterior) diameter of shaft, 4·0 (14·1), 7·8 (11·0).

The femur is thus in close agreement with that of the larger species in its main proportions, but is more slender; the minimum diameter of the shaft going 2·6 times into the maximum breadth across the trochanters, as against 2·0 in *tridactylus.* The disproportion between the antero-posterior and transverse diameters is also greater in *morgani,* the bone being more distinctly compressed from side to side. The head is less developed, and so also is the tuberosity on the posterior surface of the shaft.

The *tibia*—Maximum length, 64·1, 95·6; proximal breadth, 9·8 (6·5), 14·8 (6·5); distal breadth, 6·8 (9·0), 10·5 (9·1); minimum breadth, 2·8 (23), 5·5 (17). The structural features concerned with articulation and muscular attachment are practically those of *tridactylus* in miniature. As with the femur, however, the shaft is more slender in comparison with the extremities. Its medial outline, as seen from behind, is slightly less sigmoid, and on the anterior border the notch below the tuberosity is deeper.

The *fibula*—In this bone the agreement in proportion is less exact, but no considerable differences can be made out. Maximum length, 62·0, 92·7; proximal breadth, 4·5 (13·7), 7·5 (12·3); distal breadth, 3·6 (17·2), 5·8 (16).

The *pes*—Twenty elements derived from both left and right feet are represented. Neither extremity can be reconstructed from them, but the main axis of the left foot can be laid down sufficiently accurately to give the approximate length of the pes.

Length of pes, 58·0, 90·5; calcaneum, 11·6 (5·0), 17·2 (5·2); second metatarsal, 21·5 (2·7), 26·9 (3·4); fourth metatarsal, 25·0 (2·3), 32·7 (2·8); first phalanx of fourth digit, 11·7 (4·9), 15·8 (5·7). In *morgani* the fourth metatarsal makes a larger contribution to the length of the foot than in *tridactylus,* presumably with a corresponding reduction in the astragalus and second and third phalanges, and the metatarsals of the syndactylus digits also show a similar elongation.

The changes in the appendicular skeleton, which occupy a prominent place in the evolution of the Macropodidae from the Phalangeridae, are somewhat less important in *Potoroüs* than in the other genera, owing to the early adoption of comparatively sedentary, and in the case of *tridactylus,* partially fossorial habits. Nevertheless, the specialization of the hind limb has already gone so far that careful comparisons of the proportional dimensions of the limbs and their segments might well be expected to bring to light any considerable differences in the phylogenetic standing of the two species under consideration. The most important of the relationships which can be deduced from the figures are:

(1) The proportional contribution of each of the three segments to the total length of both fore and hind limb. Under this head five out of the total six sets of segments have been tested, and the agreement between the two species found to be very close. The greatest divergence is in the pes, where it amounts to no more than 3%.

(2) The length of the fore limb in relation to the general bodily size of the animal. In assessing this relationship, I have taken the length of the vertebral column from atlas to sacrum (inclusive) as a rough index of the size of the animal, and expressed the length of humerus, plus antibrachium, as a percentage of it. This gives 50% for *morgani,* 46% for *tridactylus;* a relative superiority of about 8% in the fore limb of the smaller animal.

(3) The length of hind limb in relation to the general bodily size of the animal. Here the agreement is almost exact, the percentages being: *morgani,* 115%; *tridactylus,* 116%.

(4) The relative disproportion in length of fore and hind limbs. It follows, from (2) and (3), that the ratio of fore to hind limb in *morgani* is as 1:2·3, and in *tridactylus* 1:2·5. In the Phalangeridae the subequal or superior fore limb is the rule, and the sole evidence of the retention of primitive characters in the limbs of *P. morgani* is, therefore, this 8% reduction in the superiority of the hind limb, as shown by the most "advanced" species, *tridactylus.*

Ribs—Twenty are represented, of which 11 are from the left side, the absentees being the eighth and thirteenth.(2) The maximum length across the arc of the first and sixth are 9·9 and 31·9, and in *tridactylus* 14·8 and 49·2, respectively. They agree closely with those of the larger species.

Vertebrae—Thirty-seven elements are present, representing 4 cervicals, 12 thoracics, 6 lumbars, the sacrum, 5 precaudals, and 9 caudals. As a disarticulated column of a sufficiently aged *tridactylus* is not available, comparison of a single accessible dimension of one vertebrae in each of five groups has been made. (The figures in brackets are the quotients of the values for *tridactylus* divided by those for *morgani.)*

Maximum transverse width of atlas, 14·1 (1·0), 23·3 (1·6); maximum height of first thoracic, 17·3 (1·0), 33·2 (1·9); maximum transverse width of sixth lumbar, 6·8 (1·0), 31·2 (1·8); maximum transverse width of sacrum, 18·9, (1·0), 32·6 (1·7); maximum transverse width of second precaudal 16·3 (1·0), 28·7 (1·7).

The disproportion between the two species is greatest in the thoracic series and is due chiefly to the exaggerated development of dorsal spines in *tridactylus.* This is, no doubt, correlated with a heavier nuchal musculature, which, in turn, is a response to the much longer and heavier head and to the greater development of the habit of rhinal excavating.

Sternum—This is represented by the manubrium, intact. It agrees exactly in form with the same segment in two immature skeletons of *tridactylus* from Victoria, but differs from the aged Tasmanian example. In the manubrium of this specimen two pairs of lateral processes are developed—possibly as an abnormality, however, as the bone is warped and unsymmetrical. Maximum breadth, 12·0 (1·0), 19·1 (1·6).

Bensley *(loc. cit.),* from a study of the dentition of *P. platyops, P. gilberti,* and *P. tridactylus,* was lead to a belief in the much more primitive position of the former, as "a form which shows an interesting approximation in many of its dental and cranial characters to *Petaurus,* suggesting an affinity with *Gymnobelideus,*" etc., etc.

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(2) Assuming 13 to be the normal number as in *tridactylus.*

While an intimate comparison of the skulls of *morgani* and *platyops* has not been possible, enough has been done in this direction to suggest that the two are upon much the same evolutionary level. It is somewhat surprising, therefore, on extending the comparison to skeletal characters, to find a relatively close correspondence between *morgani* and the much larger, (and in cranial anatomy) more specialized *tridactylus*. Though there are definite minor structural differences to be seen, and minor differences in proportion have been demonstrated, these are mostly of a kind to be associated with inferior size, weight and musculature, and surface, rather than subsurface feeding habits. The attempt to disclose a greater residuum of primitive phalangerine characters in the smaller animal by systematic mensuration, has served chiefly to emphasise the close detailed correspondence of bone for bone; a correspondence which might well be further increased if the range of individual variation could be taken adequately into account.

On the whole (if *morgani* can be taken as representing *platyops)*, it would appear that the osteology of *Potoroüs* as a genus is at least as stereotyped as that of *Bettongia*, and that the differentiation of *tridactylus* from the smaller species is a comparatively superficial and perhaps very recent change.

SKULL DIMENSIONS OF **Potoroüs morgani** SP. NOV., IN COMPARISON WITH THOSE OF P. PLATYOPS (GOULD)

Columns 1 and 2 Skull dimensions of the cotypes of *P. morgani* (in m.m.s.)
Column 3 Skull dimensions of the type (♂) of *P. platyops* (in m.m.s.)
Column 4 Mean skull dimensions of the cotypes of *P. morgani* expressed as percentages of the basal length
Column 5 Skull dimension of *P. platyops* as percentages of the basal length

	1	2	3 (3)	4	5
Dental condition	P^4M^4	P^4M^4	P^4M^4		
Greatest length	57·4	61·3	—	—	—
Basal length	47·8	51·5 (ca.)	50	100	100
Zygomatic breadth	32·3 (ca.)	35·1	35	67·9	70·0
Nasals: length	—	25·0	24	50·4	48·0
Nasals: greatest breadth	11·5 (ca.)	11·0	13	22·6	26·0
Nasals: least breadth	4·3 (ca.)	4·3	4·6	8·6	9·2
Depth of anterior nares	8·9	—	—	17·9	—
Interorbital constriction	15·0	16·2	14·6	31·4	29·2
Palate: length	30·5 (ca)	34·7 (ca.)	30	65·7	60·0
Palate: breadth inside M^2 (4)	8·8	9·4	10	18·3	20·0
Anterior palatine foramina	2·0	—	2·1	4·0	4·2
Diastema	8·1	—	7·8	16·3	15·6
Basicranial axis	15·0 (ca.)	15·1	—	—	—
Basifacial axis	33·0	36·5	—	—	—
Facial index	220	241	—	230·5	—
Ms^{1-3} length	9·8	9·8	8·9	19·7	17·8
P^4 length	—	5·0	4·9	10·0	9·8
M^4 length	2·0	2·0	2·1	4·1	4·2

(3) Ex O. Thomas
(4) Anterior lobe

REFERENCES

(1) THOMAS, O. 1888 British Museum Catalogue of Marsupials and Monotremes

(2) WATERHOUSE 1846 "Nat. Hist. of Mammalia, **1**, 231

(3) BENSLEY 1903 Trans. Linn. Soc. London (2), **9**, 147-150

EXPLANATION OF PLATES V, VI, VII

illustrating the osteology of **Potoroüs morgani** sp. nov.
All figures approx. x 1-2

PLATE V

Figs. A and B Superior views of the skulls of the cotypes
Figs. C and D Palatal views of the same
Figs. E and F Lateral views of the same
Fig. G. Outer aspect of a left mandibular ramus
Fig. H Inner aspect of a right mandibular ramus

PLATE VI

Fig. I Posterior view of right femur
Fig. J Anterior view of right tibia
Fig. K Anterior view of right femur
Fig. L Outer (lateral) view of right tibia
Fig. M Outer (lateral) view of right fibula
Fig. N Dorsal view of calcaneum of right pes
Fig. O Dorsal view of fourth metatarsal of right pes
Fig. P Dorsal view of first phalanx of right pes
Fig. Q Dorsal view of pelvis
Fig. R Ventral view of pelvis
Fig. S Ventral view of right epipubic
Fig. T Lateral (outer) aspect of right scapula
Fig. U Anterior aspect of right humerus
Fig. V Lateral aspect of right radius
Fig. W Lateral aspect of right ulna
Fig. X Antero-dorsal aspect of right scapula
Fig. Y Postero-lateral aspect of right humerus
Fig. Z Medial aspect of right ulna
Fig. A Medial aspect of right radius

PLATE VII

Figs. B to L Ventral aspect of the ribs of the left side; the eighth and thirteenth (?) absent
Fig. M Dorsal view of a caudal vertebra
Fig. N Dorsal view of the first precaudal vertebra
Fig. O Dorsal view of the sacrum
Fig. P Anterior view of the sixth lumbar vertebra
Fig. Q Anterior view of the first thoracic vertebra
Fig. R Ventral view of the presternum
Fig. S Anterior view of the atlas